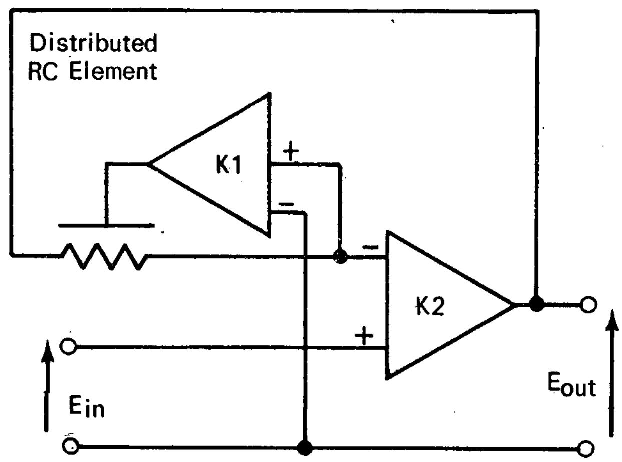
NASA TECH BRIEF

Ames Research Center

Multiloop Distributed RC Active Networks

Analysis has shown that the use of a distributed RC active two-port network and a voltage amplifier provides a unique advantage over the use of lumped elements in that an essentially second-order band-



pass function can be obtained with a single distributed passive element (a monolithic distributed RC structure). This results in an active RC filter having "zero" Q sensitivity to passive element variation, which is desirable for performance stability with integrated networks. The voltage gain required even for high Q in a single-loop (positive or negative feedback) network is less than one, but the Q sensitivity to amplifier gain change is very high. The incorporation of both positive and negative feedback loops (see fig.) provides a considerable improvement in Q, sensitivity, and gain-Q sensitivity product compared to the single-loop networks.

The amplitude response of the network was measured when operating with K1 = 0.59 and K2 = 4.0 (K1 and K2 being the voltage gains). Compared to an expected Q of 50 under these conditions, the measured Q was 49. The expected frequency of a peak response using these values (and RC time constant = 109 μs) is 28 kHz, compared to a measured value of 26 kHz. The difference is probably due to a small amount of amplifier phase shift at the operating frequency. The improvement in stability (gain-sensitivity product) for a given Q is about a factor of 6.

Design equations have been developed to allow various optimizations depending on the specific requirements: for example, equal Q sensitivities to change in the gain of either amplifier, or equal gain-sensitivity products for the two amplifiers. The use of the distributed-RC multiloop network not only eliminates the Q sensitivity to passive-element variation, and reduces the Q sensitivity to gain change, but also allows frequency tuning by varying the dc bias on a depletion layer capacitance in the monolithic distributed-RC structure without affecting the resonant Q.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: TSP71-10177

Patent status:

No patent action is contemplated by NASA.

Source: William J. Kerwin
Ames Research Center
(ARC-10200)

Category 01